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(54) A solar energy collector element

(57) A solar energy collector element comprising an elongated water carrying tube (1) from which one or more fins (2) project generally radially to a distance at least equal to the tube diameter. The tube (1) and fins (2) are made of a heat conducting material e.g. copper, and are provided with a black coating to enhance heat absorption. An outer transparent tube (3) houses the tube (1) and fins (2) and is sealed and either evacuated or filled with an inert gas.

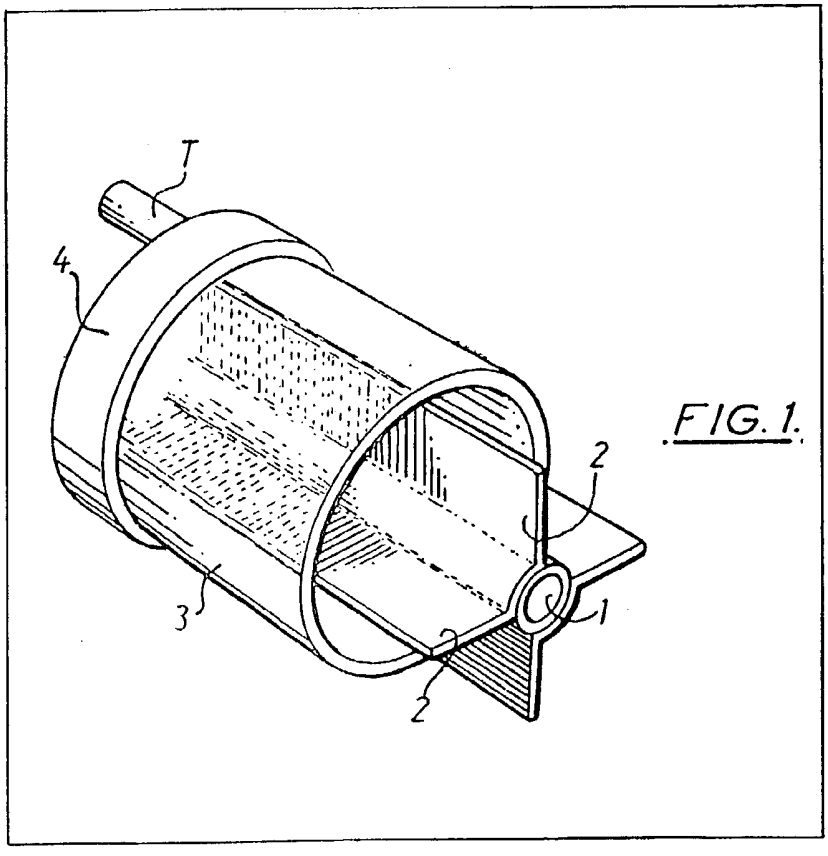

FIG. 1.

The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

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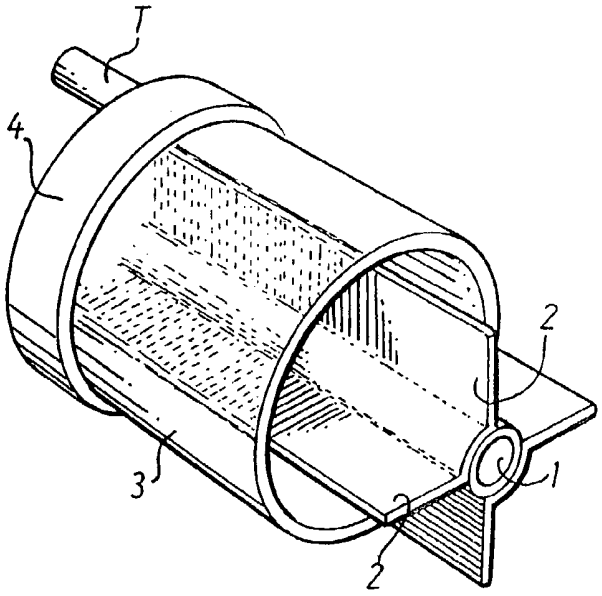


FIG. 1.

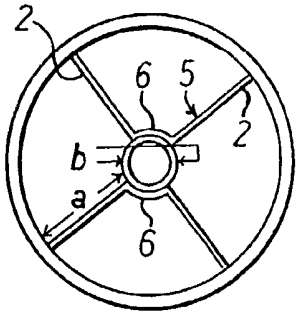


FIG. 2.

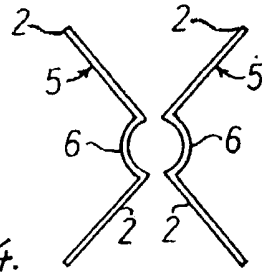


FIG. 4.

FIG. 5.

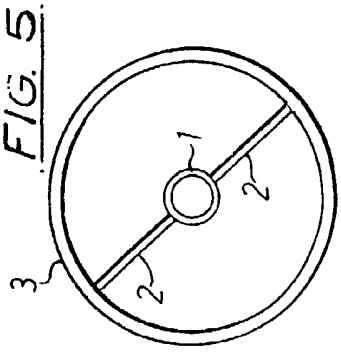


FIG. 7.

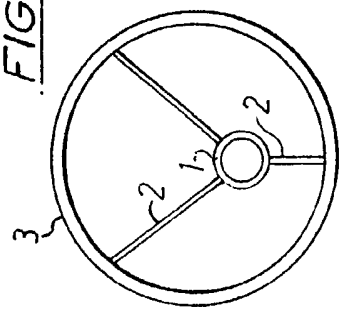


FIG. 6.

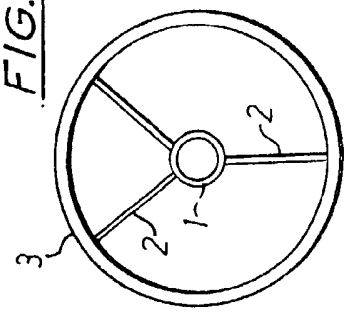


FIG. 3.

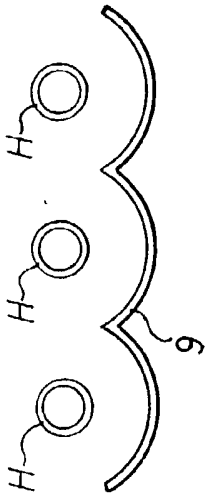
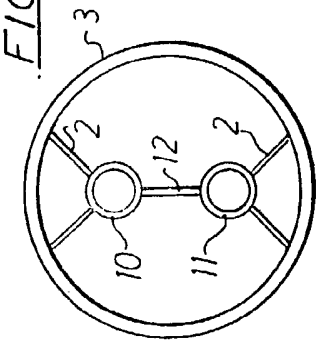


FIG. 8.



SPECIFICATION

A solar energy collector element

The present invention relates to a solar energy collector element which forms the basis of a solar panel suitable for incorporation in a system designed to heat a liquid which will normally be water.

The aim of the present system is to provide in a basically tubular design, a solar energy collector module which lends itself to great flexibility in the design and installation of composite solar panels which have an improved performance relative to cost in comparison with previously known arrangements.

According to the present invention there is provided a solar energy collector element comprising an elongated tube constructed from a heat conducting material and located within a transparent outer tube, at least one fin also made of heat conducting material, being integrally attached to said elongated tube to ensure good thermal contact therewith, the or each fin extending along at least part of said elongated tube and projecting out from said elongated tube a distance at least equal to the diameter of said elongated tube.

In a preferred embodiment of the present invention the elongated tube is made of copper and four generally radially outwardly extending fins are secured to said elongated tube, the fins likewise being made of copper. Alternatively the elongated tube and fins may be made of another suitable material e.g. aluminium. The fins extend for virtually the complete length of the elongated tube and extend outwardly a distance which is approximately two and a half to three times the diameter of the elongated tube. Preferably the fins are equi-angularly spaced about the elongated tube so that, in use with the elongated tube generally horizontal, the solar energy collector thus formed receives the same quantity of heat from the sun irrespective of its rotational position about the axis of the elongated tube.

The heat conducting elongaged tube and fins have a suitable black surface to enhance the absorption of solar energy.

The finned tube is located within the transparent tube primarily by means of suitable end connections, although in some arrangements the fins themselves may participate in this inner tube location i.e. the fins may engage the inner wall of the transparent tube. The end connections are sealed to enable a vacuum to be maintained in the space between the inner tube and the outer transparent tube, though alternatively, this space may be filled with an inert gas. The transparent tube is preferably a glass tube but any suitable alternative e.g. a plastic tube, may be used.

In use, the solar energy collector tube modules are connected in a solar heating system such that the tube modules are preferably parallel and separated by a space and, to improve performance, suitable reflectors may be positioned behind the tube absorber modules.

The provision of the relatively large area fin or fins, in effect increases the surface area of the heat collector relative to the amount of water which can flow through the small diameter of the tube. Thus compared to known solar panels utilising the tubular concept, the amount of water contained by the said elongaged tube for the same diameter outer tube is very small, thus giving the advantage of a correspondingly small thermal inertia. The efficiency of the present invention is enhanced by the use of good thermal conducting materials e.g. copper, and the provision of a good absorption surface with low emissivity.

In alternative embodiments of the present invention any number of fins may be provided, though preferably there are not more than five fins. Further, where two or more fins are provided, the fins need not be of equal radial dimensions, though each fin must have a radial dimension which is greater than the diameter of the tube through which the water is passed.

In one alternative embodiment two water carrying tubes are provided in a single transparent tube, each water carrying tube being provided with two generally radially extending fins together with a third fin which extends between said water carrying tubes. The water carrying tubes may be parts of one U-shaped tube so that water flows in effect twice along the same solar energy collector element.

Whilst the fins may be attached to a preformed tube when constructing a heat collector according to the present invention, it is envisaged that the tube may alternatively be formed by securing two sections together, the fins already being integral with said sections. For example, in the case of a four fin embodiment, two generally W-shaped sections may be intimately bonded e.g. welded together to immediately form the heat collector.

To enhance the operation of a collector element constructed according to the present invention, the elongated tube and fin or fins may be wrapped in a clear plastics film e.g. a fluorocarbon, to produce a double glazing effect.

The present invention will now be further described, by way of example, with reference to the accompanying drawings, in which:—

Fig. 1 is a partially cutaway perspective view of one embodiment of the present invention,

Fig. 2 is a transverse cross-sectional view of the embodiment of Fig. 1,

Fig. 3 diagrammatically illustrates a possible arrangement for a number of heat collectors constructed according to the present invention,

Fig. 4 diagrammatically illustrates an alternative method of constructing the heat collector of Figs. 1 and 2,

Fig. 5 is a transverse cross-sectional view of a two fin embodiment of the present invention,

Fig. 6 is a transverse cross-sectional view of a three fin embodiment of the present invention,

Fig. 7 is a transverse cross-sectional view of a modified form of Fig. 6; and

Fig. 8 is a transverse cross-sectional view of a still further embodiment of the present invention.

The embodiment of the present invention illustrated in Figs. 1 and 2 of the accompanying drawings comprises a tube 1 for carrying water to be heated, and four fins 2 extending generally radially from the tube 1, the tube and fins being located within a transparent tube 3 which is sealed at each end by end caps 4. The tube 1 and fins 2 are made of copper and provided with a suitable coating to present a black body absorber but with low emissivity. Alternatively the tube 1 and fins 2 can be made of any other suitable heat conducting material e.g. aluminium. The transparent tube 3 is made of glass though alternatively the tube 3 can be made of a suitable plastics material, and it is at least partially evacuated to reduce the possibility of deterioration of tube 1 and tube 2 over a period of time. Alternatively tube 3 may be filled with an inert gas.

The fins 2 are secured to the tube 1 in two sections 5, each section being substantially W-shaped (see Figure 2) and comprising two fins 2 and a central curved portion 6. The curved portions 6 are attached to tube 1 to form the heat collector element. Alternatively, as is evident in Fig. 4, the tube 1 can be omitted and the curved portions 6 of each W-shaped section 5, can be made substantially semi-circular. Then by securing regions 7 and 8 together, the heat collector element is formed.

A number of solar energy collector elements as per Figs. 1 and 2 can be arranged in substantially parallel relationship, to form a solar heating panel. To enhance the performance of such a panel, reflectors 9 (see Fig. 3) can be located beneath the solar energy collector elements H.

Various other embodiments are possible within the scope of the present invention and some of these are illustrated in Figs. 5 to 8. The embodiment of Fig. 5 has solely two fins which extend in generally opposite directions. In use, the solar energy collector element of Fig. 5 is preferably located with the axis of the tube horizontal in a specific rotational position with respect to the axis of tube 1, so that its fins can have the best chance of absorbing the sun's rays in a particular installation. This is not however necessary with the embodiment of Fig. 1 and 2 where nearly the same surface area is presented irrespective of the rotational position of the heat collector. Similarly with the embodiment of Fig. 6 where three equi-angularly spaced fins are provided, nearly the same surface area is always available for heat absorption. Fig. 7 shows a modification of the embodiment of Fig. 6, wherein one of the three fins is shorter than the other two fins, thus locating tube 1 off centre with respect to transparent tube 3.

In the embodiment illustrated in Fig. 8, two water carrying pipes 10 and 11 are provided within the one transparent tube 3, the pipes 10 and 11 each having two outwardly extending fins 2 as per the previous embodiments, but being interconnected by a further fin 12. If desired pipes 10 and 11 can be the arms of a U-shaped pipe wherein connections are only necessary at one end of the heat collector element, the water flowing in effect twice along the length of the heat collector to thus further increase the heat absorbed and the temperature attained.

In any of the above described embodiments the performance can be enhanced by wrapping the elongated tube and fins in a clear plastic film within the outer tube. This produces a double glazing effect.

CLAIMS

1. A solar energy collector element comprising an elongated tube constructed from a heat conducting material and located within a transparent outer tube, at least one fin also made of heat conducting material, being integrally attached to said elongated tube to ensure good thermal contact therewith, the or each fin extending along at least part of the elongated tube and projecting out from said elongated tube a distance at least equal to the diameter of said elongated tube.

2. A solar energy collector element as claimed in claim 1, in which four generally radially outwardly extending fins are secured to said elongated tube.

3. A solar energy collector element as claimed in claim 2, in which said four fins are formed in cross-section by two substantially W-shaped sections, each section comprising two fins and a central curved portion which is secured to said elongated tube.

4. A solar energy collector element as claimed in claim 1, 2 or 3, in which the fins are equi-angularly spaced about the elongated tube.

5. A solar energy collector element as claimed in any one of the preceding claims in which the or each fin extends for virtually the complete length of the elongated tube and extends outwardly a distance which is approximately two and a half to three times the diameter of the elongated tube.

6. A solar energy collector element as claimed in any one of the preceding claims, in which the elongated tube and the or each fin, have a suitable black surface to enhance heat absorption.

7. A solar energy collector element as claimed in any one of the preceding claims, in which a number of fins are provided, at least one of which is shorter than the other fins.

8. A solar energy collector element as claimed in any one of the preceding claims in which a clear plastic film is wrapped around the fin or fins and the elongated tube, within said transparent outer tube.

9. A solar energy collector element as claimed in any one of the preceding claims, in which the elongated tube is located in the transparent outer tube and supported therein by end connections which are sealed to said tubes.

10. A solar energy collector element as claimed in any one of claims 1 to 9, in which the fins engage the inner wall of said outer tube to locate said elongated tube in the required position.

11. A solar energy collector element as claimed in claim 9 or 10, in which said outer tube is

evacuated.

12. A solar energy collector element as claimed in claim 9 or 10, in which the outer tube is filled with an inert gas.

13. A solar energy collector element as claimed in claim 1, in which two elongated tubes are located in said transparent outer tube, the elongated tubes being inter-connected by a common fin with further fins supporting the elongated tubes in said outer tube.

14. A solar energy collector element as claimed in any one of the preceding claims, in which the outer tube is a plastics tube.

15. A solar energy collector element as claimed in any one of claims 1 to 13, in which the outer tube is a glass tube.

16. A solar energy collector element as claimed in any one of the preceding claims, in which the elongated tube and fin or fins are made of copper or aluminium.

17. A plurality of solar energy collector elements, each one as claimed in any one of the preceding claims, said elements being arranged parallel to one another.

18. A plurality of solar energy collector elements as claimed in claim 17, in combination with a series of reflectors.

19. A solar energy reflector element, constructed and arranged substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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ABSTRACT: